MULTI-COLOR INJECTION MOLDED DOOR PANEL AND PROCESS

Field of the Invention

The present invention relates generally to a process of molding a plastic part comprised of more than one material, and to an injection molding tool for making a part such as but not limited to a door panel that is made with multi-colored or multi-material parts.

Background and Summary of the Invention

It is well known to use the process of injection molding for creating plastic parts that are used in the automotive industry. Typical molding processes will use a single-colored plastic part that has consistent coloring throughout the entire part. Interior automotive components, such as door panels, traditionally use one color throughout the entire door panel. However, the appearance is not aesthetically appealing. Alternatively, door panel assemblies were created comprising separate inter-connectible parts having one or more colors that fit together to make a final door panel assembly. However, these conventional practices have problems such as the multiple door panel components not fitting together with a clean fit once the assembly is completed. Thus, it would be desirable to overcome these problems.

One of the previous methods of making a multi-colored part utilizing an injection molding machine required machine tooling that had numerous working parts that were necessary for each step of the color molding process. These machines were capable of injection molding parts that have different materials as well. Other methods of manufacturing multi-colored and multi-material plastic parts utilized large band areas, that is the area separating different portions of the plastic part from the rest of the colored plastic part. The band surrounds each object to be covered differently, but the problem with the band areas is that they inherently create dead spots from which non-reflective areas are created. If a reflective part is desired, it would be undesirable to have these dead spots since it is preferred to maximize reflective areas.

Another method of injection molding plastic parts includes the rotary method where the mold is rotated between the shot processer so as to create multiple colored parts. However, rotary machines require large tonnage and hence significant capitol investment.

Accordingly, it is desirable to provide a tool for manufacturing multi-colored plastic parts and multi-material plastic parts that reduce scuffing, warpage and shrinkage. It is also desirable to provide a tool for use in injection molding a multi-

colored part through a one step process of not opening the mold during the creation of different colored sections of the final part. It is also desirable to provide a tool that is operable to injection mold a part made of multiple materials that can be injection molded in a single process without opening the mold when the different materials are being shot. Thus, it is preferred to maintain the parting line closed which will reduce scuffing, warpage and shrinkage.

One aspect of the invention includes an improved mold having a pair of clamping plates, a cavity block, a core block, an inner-insert mechanism assembly comprised of retainer pins, retainer slides and slide holders, a spacer mechanism, a moving mechanism retainer plate for holding the spacers in place, springs positioned between the core block and the retainer plate, a clamp plate, an ejector retainer plate, an ejector plate, a manifold retainer plate, a manifold plate, a first shot manifold assembly, a second shot manifold assembly, ejector cylinders, a set of full length parallels, and cylinders for advancing the spacers.

It is also desirable to provide a process of manufacturing a multi-colored part, such as a multi-colored door panel, that overcomes the previously mentioned disadvantages. It will be appreciated that said process can be used on a variety of interior and exterior automotive components, and is not limited to the door panel described herein, which is discussed for illustrative purposed only and is not intended to limit the present invention. It is also desirable to provide a process of manufacturing a multi-colored and multi-material part that decreases cycle time, yet increases part quality, and has improved gas removal during the molding process in order to minimize imperfections in the surface of the part. It would also be desirable to provide a process which results in reducing the amount of scrap material. It is also desirable to provide an improved process of manufacturing a multi-colored part that has improved tolerances with a cleaner fit between the various colored and materialed components within the final part.

According to another aspect of the present invention, a process of making a multi-colored injection molded part includes the steps of providing a mold, closing the mold, injecting plastic of a first color into the mold to create a first part, releasing the machine clamp pressure, adjusting a spacer mechanism to offset an inner-insert from the cavity of the first shot, applying tonnage and then injecting plastic of a second color to another part of the mold to create a second part, and opening the mold and ejecting the completed part. The entire process is performed while maintaining the parting line closed.

Another aspect of the present invention includes a multi-colored part, for example a door panel assembly, with a first portion made of a first type of material, for example, of one color, or of one type of material, and a second portion made of a different material or of a different color. The assembly is made through an injection molding process where the parting line of the mold stays closed during the creation of both parts in order to create the final assembly. Thus, shrinkage and warpage issues are minimized, enhancing fit and quality of the final assembly.

For the following specification taken in conjunction with the accompanying drawings, independent claims, other objects, features, and advantages, the present invention will become apparent to those skilled in the art.

Brief Description of the Drawings

Figure 1 is a side sectional view of a mold for making a door panel, illustrating the present invention with the spacer and inner-insert assembly, when located in the first shot position.

Figure 2 is a front view section of the figure one mold, illustrating the four spacers and inner-insert assembly, when in the first shot position.

Figure 3 is an enlarged side view of the spacer mechanism shown in figure one, while in the first shot position.

Figure 3A is an enlarged view taken from the circle 3A of figure 3, showing the first shot part relative to the core block, inner insert and cavity block.

Figure 4 is an enlarged side view of the spacer mechanism advanced to the right which is the second shot position.

Figure 4A is an enlarged view taken from the circle 4A of figure 4, showing the second shot part relative to the first shot part.

Figure 4B is an enlarged view taken from circle 4B of figure 4 (shown out of position), showing the second shot gate.

Figure 5 is a top view of the mold of the present invention showing the spacer mechanisms relative to the hydraulic cylinders, retractor pins and inner insert.

Figure 6 is a completed two-colored molded door panel utilizing the process of the present invention.

Detailed Description of the Preferred Embodiments

Figure 1 illustrates an injection molding tool 10 for making a multi-colored or multi-materialed part 12. For illustration purposes only, the following discussion is of a mold 10 for making an automotive door panel 12 which is illustrated in Figure 6. It will be appreciated that the present invention can be utilized for making a wide variety of components where it is desireable to have a single part comprised of more

than one material. It will be appreciated that the materials can be made of polypropylene, polycarbonate, TPO, and others. Moreover, the present invention is operable to make finished parts having multi-colors and/or multiple textures. Further, the present tool allows an operator to run two or more shots without opening the mold during the molding process.

With continued reference to figure 1, the injection tool 10 includes a lower clamp plate 14 and an upper clamp plate 16. Affixed to the lower clamp plate 14 is a mechanism retainer plate 18 with a spacer gap 20. A mounting pad 22 is affixed to the lower clamp plate 14 and supports a means for activating a spacer. For example, hydraulic cylinders 24 are secured to the mounting pad 22 and as illustrated in figure 5, three separate hydraulic servers 24 are provided for imparting uniform pressure on a spacer mechanism assembly 26. Rod extensions 28 interconnect each hydraulic cylinder 24 to the spacer mechanism assembly 26.

As illustrated in figures 1, 2 and 5, the spacer mechanism assembly 26 includes a driver 30 that is connected to the rod extensions 28 on one side, and to a set of four spacers 32 that traverse within four separate gib assemblies 34 within the mechanism retainer plate 18. Each spacer 32 has a T-shaped portion for sliding within the gib assemblies 34 when the hydraulic cylinders 24 impart motion thereto. A stationery spacer 36 is in each of the locating gib assemblies 34 and stationery spacer 36 is housed within a lower recess 38 of the core 40. The stationery spacer 36 has corners 42 and together the spacers 32 and 36 make metal to metal contact when the spacers 32 advance to the right (second shot position) after the clamp tonnage has been re-applied. Spacer 32 is shown in the first shot position in figures 1 and 3.

The tool 10 further includes a core 40 which is one half of the mold and it receives a retractor or a inner insert 44 with a finished surface 46. The inner insert 44 is positioned at an angle to cause both a vertical and horizontal displacement in order to allow for the space required for the second injection shot. The inner insert mechanism assembly 44 is the part of the mold that the plastic is injected against in order to create a part, and in this instance, the part is an automotive interior door panel. The inner insert mechanism assembly 44 includes four retainer pins 50, four retainer slides 52 and four slide holders 54. The insert assembly 44 is secured to the moving mechanism retainer plate 18 while the core 40 moves relative thereto. This arrangement allows the spacer mechanisms 32 to slide relative to the moving mechanism retainer plate 18.

With reference to figure 2, the tool 10 further includes a set of parallels 56 positioned above the cavity block 48, an ejector retainer plate 58, an ejector plate 59, a set of ejector cylinders 60, a manifold plate 62 and a clamp plate 64. The ejector plate 59 and ejector retainer plate 58 are connected through tee slots to the manifold retainer plate 61. The hydraulic ejector cylinders 60 are attached to the ejector plate 58 and they help eject the part 12 when the process is finished (during the ejection stage). The parallels 56 are located on each side of the ejector plate and ejector retainer plate. On one side one parallel is attached to the manifold retainer plate and the opposite parallel is only attached to the manifold retainer plate. The parallel height minus the ejector plate thickness determines the ejector stroke. The empty space within the mold provides the ejection stoke. Within the manifold plate 62 are standard heaters and flow channels that make up a manifold assembly 66 which includes first shot injector nozzle assembly 68 and a second shot injector assembly 70. The material flows from the machine nozzle through the manifold, down the nozzle drops, through the runners and in to the part. The material injected first could be polypropylene and the second could be thermo plastic elastomer (TPE). Heaters surround the outside diameter of the nozzles to keep the plastic in a liquid state until it reaches the runners.

A set of coil springs 72 are positioned within the moving mechanism retainer plate 18 as shown in figures 2 and 5. The springs 72 maintain an upper biasing force against the core block 40 to maintain the parting line 74 closed during the molding process. Maintaining the parting line 74 closed during the first shot and second shot processes is critical to the present invention. It will be appreciated that other means for biasing the core 40 upward, can be contemplated. For example, hydraulic mechanisms can be applied in order to maintain the upper biasing pressure so as to maintain the parting line closed during the molding process. Shifting the mechanical components within the mold while maintaining the parting line closed during the entire injection process, allows for reduced shrinkage, flashing and warpage of the final part 12.

Figure 2 is a front sectional view of the tool 10 illustrating the various components of the present invention. Each spacer mechanism 32 is shown juxtaposed to gib 34 which in turn is secured to the spacer cavity 34 by fasteners 78.

The tool 10 has three separate nozzles, nozzles 68 for the first shot and nozzle 70 for the second shot. It will be appreciated that the present invention contemplates being operable in environments where more than two colors or more

than two different materialed parts can be made, and therefore, additional ejector nozzles are contemplated.

Figure 3 illustrates the figure 1 embodiment in greater detail where the inner insert assembly 44 has a set of four retainer pins 50, (only two shown in the figure 3 side section), wherein at that the distal end 80 of each retainer pin, a bolt 82 is threaded thereto for securing the inner insert 44 to the retainer slide 52. Figure 3 further illustrates the first shot part 84 after it has been injection molded, with the parting line 74 maintained in the closed position.

Figure 3A further illustrates the first shot part 84 after the first injection step. A recess 86 provides a void or cavity for the second shot material to be inserted during the second shot process. The outer surface 88 of the first shot part 84 has a butting edge 90 that will mate with a corresponding butting edge of the second shot material. It will be appreciated that overlapping edge designs could be employed as well.

Figure 4 illustrates the tool 10 in the second shot position 92. This is accomplished by first dumping the clamp tonnage and opening the press to the desired distance which separate spacers 32 and 36. Hydraulic cylinders 24 can now impart motion in the direction of arrow 94 by advancing the spacer mechanism assembly 26. The advancement of the spacer 32 now occurs which allows it to be repositioned under the stationery spacer 36. The press is then closed and the tonnage is then reapplied thus separating core 40 from the mechanism retainer plate 18. This causes a gap split 98 between the core block 40 and the mechanism retainer plate 18. This gap does not occur in the first shot position, as seen at closed split 100 of figure 3. Because the inner insert remains stationery, the core block 40 around it shifts the face 102 of the inner insert 44 in an amount equal to the recess which equals the second shot wall thickness as shown in figure 3A. This defines the cavity for the second shot material to be injected into during the second shot phase. The clamp tonnage can now be re-applied at approximately 1500 tons.

Figure 4A illustrates the second shot part 104 after having been injected. It has an exterior finished surface 106 with a well bonded joint 108 or interface that butts up against the corresponding edge 90 of the first shot part 84. The sections essentially fuse together during the molding cycle.

Figure 4B illustrates in detail the second shot gate configuration. Here the second shot injector 70 injects hot plastic through the runner 110 and then into the gate 112 for dispersion within the cavity 114. Once injected, second shot part 104 is

created adjacent to the first shot part 84. The insert assembly 44 is shown relative thereto.

Figure 5 illustrates a top view of the lower clamp plate 14, the spacer mechanism assembly 26, the moving mechanism retainer plate 18, the four guides 71 and the inner insert assembly 34. The moving mechanism retainer plate 18 is on the moving side of the press and thus shifts when the press is open. A split line 35 opens when the tonnage is dumped and press is opened to a desired height distance. Ten springs 72 extend above a surface of the mechanism retainer plate 18 and (in the uncompressed state) aid in maintaining pressure against the core block 40 so as to maintain the parting line 74 closed relative to the cavity block 48. To return the tool 10 to the first shot position, the tonnage is dumped, the press is opened to the desired distance and then spacer mechanism 32 is shifted in a direction opposite arrow 94 so as to allow the core block 40 to shift in a downward direction to the position illustrated in figure 3. This device does not utilize any wedges.

Figure 6 illustrates a completed part 12 comprised of at least two distinct materials. The first material 84 was injected during the first shot process, and the second material 104 was injected during the second shot process. The completed part 12 has not yet been trimmed or finished and the runners are still showing. It will be appreciated that the door panel 12 could be manufactured utilizing the present process to have more than two different materials or colors by employing the unique closed parting line process.

A description of the process of manufacturing a multi-colored or multi-materialed part utilizing the present invention will now be presented. With reference to figure 3, the spacer mechanism 32 is located in the first shot position after the tool 10 has closed. The parting line 74 maintains closure throughout the injection process. The first shot injector nozzle assembly 68 delivers a first material through the cavity block 48 to create a first shot part. The part starts to cool at this step of the process. The stationery cavity block 48 remains closed during this period. Next, the clamp tonnage is dumped and the press is opened to the desired distance. All movement is done by the moving side of the injection machine which is on the lower clamp 14 side of the tool 10. Thus, clamp 14 and mechanism retainer 18 advance downwardly in the direction of arrow 96 (Fig. 4) with the ram when tonnage is dumped. Next, spacer 32 is shifted in place by moving in the direction of arrow 94 (Fig.4). The press then closes and tonnage is reapplied. A separation or gap 98 then occurs between the mechanism retainer plate 18 and the core block 40 which

results in the inner insert 44 to become off-set from the first shot part 84. This off-set clearance 86 (figure 3) in part defines the new cavity area for the material of the second shot part 104 to be molded into during the second shot process.

When the core 40 shifts, each biasing spring 72 continues to apply pressure against the core block 40 so as to maintain the parting line 74 closed continuously during the process. The clamp tonnage is now applied to the mold whereby a second set of materials can now be injected through second injector assembly 70 to create a second shot part 104. A well bonded joint 108 is thereby created having a tight fit configuration. Because of the molding process, the two parts are essentially fused thus enhancing the appearance and fit. Once the part 12 cools, the mold is opened and the cylinder ejectors 60 cause the part 12 to be ejected.

Those skilled in the art can now appreciate from the foregoing description that the broad teachings of the closed parting line invention can be implemented in a variety of forms. Therefore, while this invention has been described in connection with a particular example of a door panel, the true scope of the invention should not be so limited, since other modifications will become apparent to the skilled partitioner upon a study of the drawings, specification and following claims.